Important Instructions to examiners:

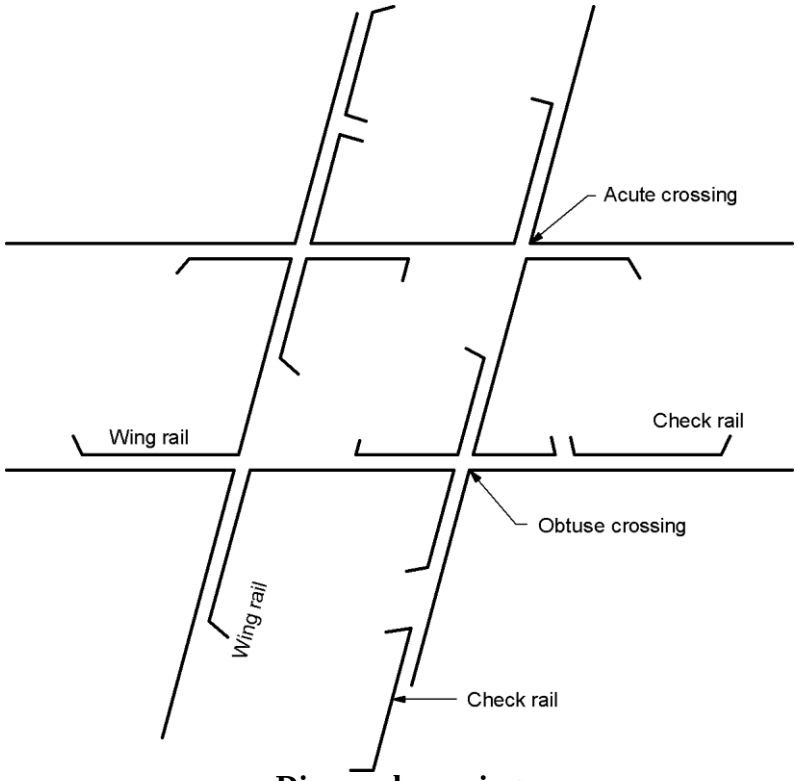
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills.)
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by the candidate and those in the model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and the model answer.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1		**Attempt any TEN of the following**		**20**
	a) Ans	**Define the term alignment in bridges** The position occupied by the center line of a bridge in plan is called bridge alignment.	**2**	**2**
	b) Ans	**Enlist modes of transportation system** The various modes of transportation system are as follows- • Road ways • Railways • Waterways • Airways	**2**	**2**
	c) Ans	**Enlist two advantages of railways** **Advantages of railways are as follows-** 1. It provides economic means of transportation for common people. 2. Traveling in railway is safe and comfortable. 3. Heavy goods and raw materials can be transported for long distance only by railway. 4. It gives the maximum revenue to the country. 5. It requires less power to drive. 6. It gives the employment to the maximum peoples. 7. Tractive resistance of railway is less.	**1 mark each (Any Two)**	**2**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**d) Ans**	**Enlist any two disadvantages of tunnel.** Following are the disadvantages of tunnels : 1. They require special equipment and method for their construction. 2. They require more time for their construction. 3. Skilled labour and supervision is required in their construction. 4. They may cause suffocation if not properly ventilated.	**1 Mark each (any two)**	**2**
	e) Ans	**Define gauge of railway track** The clear horizontal distance between top of the inner faces of two rails on the railway track is called as gauge of railway.	**2**	**2**
	f) Ans	**Enlist any four types of tunnels as per shapes** The various types of tunnels as per shapes are 1. Rectangular or box type shape 2. Circular shape 3. Segmental shape 4. Horse shoe shape 5. Egg type shape 6. Elliptical shape 7. Poly – centric shape	**½ mark each (any four)**	**2**
	g) Ans	**Define HFL and free board** **H.F.L. :** The level of the highest flood ever recorded or the calculated level for the highest possible flood is called Highest Flood Level (H.F.L.) **Free board :** The difference between the highest flood level after allowing the afflux if any and the lowest point on the underside of the bridge superstructure is called free board.	**1** **1**	**2**
	h) Ans	**State the necessity of track maintenance** The necessity of track maintenance arises due to the following reason- 1. Due to weathering effects, the wear and tear of track component is likely to take place. 2. The new track may be disturbed due to heavy axle load, frequency in trains. So it has to be checked frequently and periodically for its alignment, gauge and surface level of rails. 3. At points and crossings on curves there might be chances of deterioration due to high speed and heavy wheel loads. 4. Due to moving loads there may be loss of ballast, wear and tear	**1 mark Each (any two)**	**2**

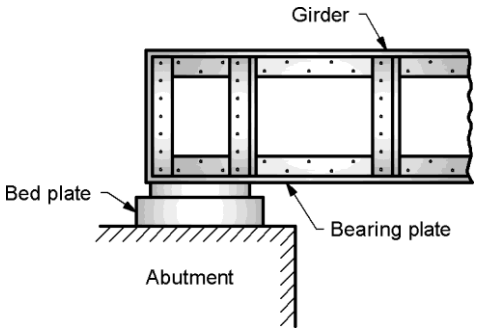
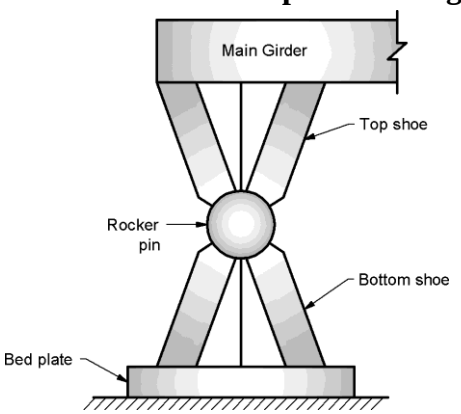
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1		of different parts of track.		
	(i) Ans	**Enlist two requirements of piers** **Requirement of piers for bridge :** 1. It should be easily and cheaply constructed. 2. It should be constructed of durable material. 3. It should have sufficient bearing area at its top to receive the bearings supporting the bridge girder. 4. It should be stable against lateral and longitudinal thrust of water. 5. It should be strong enough to take loads. 6. It should involve less maintenance cost.	**1 mark Each (Any two)**	**2**
	(j) Ans	**Define bearings and approaches** **Bearings** The devices fixed on abutments and piers for free expansion, contraction and deflection of the bridge superstructures are known as bridge bearings **Approaches** The length of communication route affected by the layout and design of the bridge, at both of its ends are known as approaches.	**1** **1**	**2**
	(k) Ans	**Define Tunnel and tunnel ventilation.** **Tunnel-** The underground passages which are constructed without disturbing the ground surface are known as tunnels **Tunnel ventilation** The art of providing freshness of air inside tunnels during or after their construction is known as ventilation in tunnels.	**1** **1**	**2**
	(l) Ans	**Define wing wall and abutment.** **Wing wall** The walls constructed on either side of an abutment to support and protect the embankment are known as wing walls. **Abutment** The end supports of bridge superstructure are known as abutments.	**1** **1**	**2**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	**(m) Ans.**	**State component parts of bridges** **Foundation** **Sub-structures** :- Abutments, Piers, Wing walls, Approaches **Super- structures** :- beams, girders, arches suspension cables	**1** **1**	**2**
	(n) Ans.	**Define permanent way and sleeper density** **Permanent way** The permanent way is the combination of ballast; rails and Fixtures. It consist of a pair of rails fixed to sleepers which rest on ballast. **Sleeper density-** It is number of sleeper used per rail length on a track is known as sleeper density.	**1** **1**	**2**
Q.2		**Attempt any <u>FOUR</u> of the following**		**16**
	(a) Ans.	**State the role of transportation in development of Nation.** Role of transportation is an essential accessory of development of nation for the following purposes : 1. Easy and quick transportation of men, machines, animals, materials and goods can be made. 2. Areas which are connected by proper means of transport can be developed fast. 3. Remote areas and rural areas become accessible and communicable if connected by proper means of transport. 4. During the days of emergency e.g. wars, efficient and developed transportation system plays a vital role for quick and easy transportation of soldiers, food and ammunition. 5. Transportation through airways also plays an important role of communication to the people staying in remote areas and also helps the people in difficulties during floods. E.g. Helicopters can help the people at the time of floods.	**1 mark Each (Any Four)**	**4**
	(b) Ans.	**Define gradients .Explain two types of gradients.** The rate of rise or fall provided to the formation of a railway track along its alignment is called as gradient. **The various types of gradients are** Ruling or maximum gradient Momentum gradient Station yard gradient Pusher gradient	**1**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	**(b)**	**Ruling gradient :** It is the maximum gradient allowed on the track over which a train is hauled by one locomotive. It is generally 1 in 150 to 1 in 200 for plane and 1 in 100 to 1 in 150 for hilly regions. **Momentum gradient :**Sometimes rising gradient is followed by falling gradient. In that case when train travelling due to falling gradient, it acquires momentum and due to which it becomes easy to travel in rising gradient. This type of gradient is known as momentum gradient. **Station yard gradient :** The gradient provided in station yard for easy drainage is known as station yard gradient. It has been recommended for easy drainage of rain water and it is in between 1 in 400 to 1 in 100 for maximum and minimum respectively. **Pusher gradient :** These are steeper than ruling gradient. In this type of gradient, an extra engine is attached to push the train and hence called as pusher gradient. These are helpful in the regions where heavy cutting is to be avoided and to reduce the route length.	**1½ mark Each (Any Two)**	**4**
	(c)	**Define Points and Crossing. Draw neat sketch of diamond crossing**		
	Ans.	Points and crossing is the special arrangement provided on rail way track to facilitate trains to be diverted from one track to another. .	**1**	**4**
		 **Diamond crossing**	**3**	

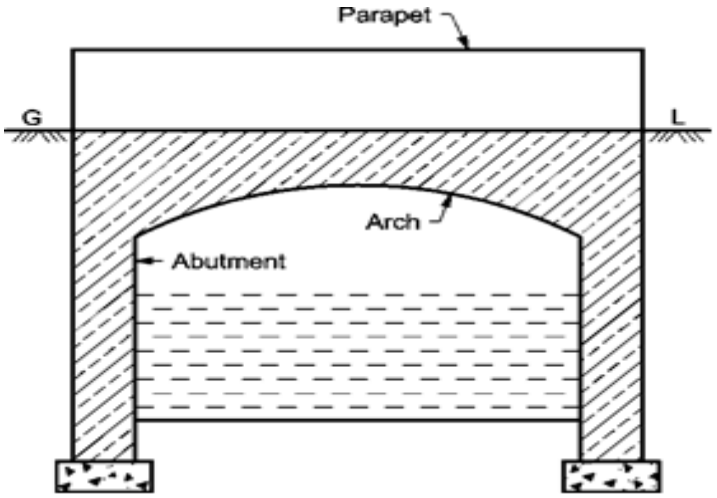
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	**(d) Ans.**	**State the duties of permanent way inspector and gang mate** **Duties of permanent way inspector -** 1. The duties of permanent way inspector are as follows; 2.The PWI is personally responsible for maintaining the track in good condition for the passage of trains. For this purpose, he travels over the track by push trolley and watches the defects of the track and arranges the repair of the defective track by his gang. 3.He is responsible to carry out the renewals of rails and sleepers. 4.He should maintain the record of wear of rails in his section. He should check out the programme for lubrication of rail joints in such a way that the entire rail joint are lubricated on a year during winter season. 5.He is responsible to maintain the correct gauge, super elevation on curves and removal of creep etc. 6.He should supervise the work of his gang regularly. 7.He should see the welfare of his gang man. 8.Level crossing under his charge must be maintained in perfect condition. During this visit to level crossing, he should check the working of gateman also. If necessary he should issue instructions to the gateman. 9.At the time of accident, he is responsible to store the traffic in the shortest possible time. He should also find out the causes of accident. 10.He should prepare the estimates of the maintenance work and should report the progress to his seniors. **Duties of gang mate-** 1.Gang mate means the person in charge of gang of work men employed on permanent way. 2.He is responsible for the maintenance of track. 3.It is his duty to arrange for tools and other requirement for his gang. 4.He has to allot duties to each of his gang man and to check their work. 5.He has to maintain record of work, reports of key man.	**1 mark each (Any Two)** **1 mark each (Any Two)**	**4**
	(e) Ans.	**State the requirements of ideal sleepers** **Requirements of ideal sleepers are as follows-** 1. They should be durable. 2. They should be able to maintain correct gauge. 3. They should have moderate weight. 4. They should be able to resist impact and vibrations. 5. They should have less maintenance cost.		

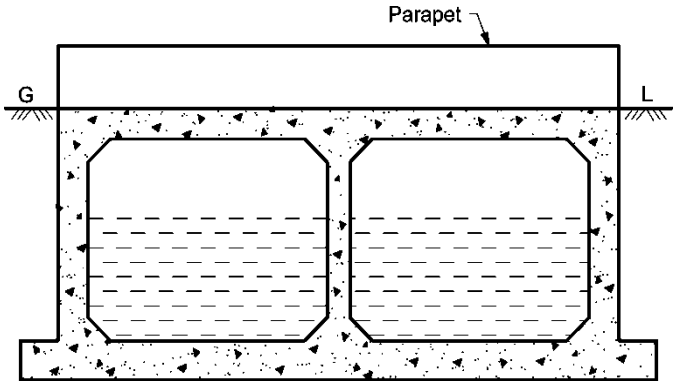
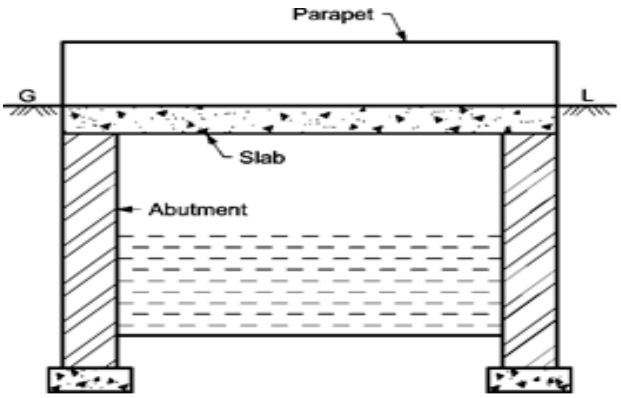
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	**(e)**	7. They should provide good holding capacity on track geometry. 8. They should able to provide good track circuiting. 9. They should have such fittings that they can easily be removed, replaced, packed and lifted when required. 10.They should be such that they will not get damaged easily during packing operations. 11.They should have high scrap value. 12.They should have non absorbent qualities.	**1 mark each (Any Four)**	**4**
	(f)	**Define stock rail, wing rail, check rail, and angle of crossing in Turnout.**		
	Ans.	**Stock rail-** It is the fixed rail in a railway track at which the tongue rail fits.	**1**	**4**
		Wing rail - The bent up length of rail used in front of nose of crossing which helps in channelizing train wheels in proper route is known as wing rail.	**1**	
		Check rails - The rails check the tendency of wheels to climb over crossing are the check rail.	**1**	
		Angle of crossing- The angle made by running faces of point rail and splice rail at a crossing is called as angle of crossing.	**1**	
Q.3		**Attempt any <u>FOUR</u> of the following:**		**16**
	(a)	**Classify bridge according to function ,material, span and alignment**		
	Ans.	Bridges can be classified into various types depending upon the following factors and condition; **1. According to functions:** a. Aqueducts b. Viaducts c. Foot bridges d. Highway bridges e. Railway bridges	**1**	
		2. According to materials: a. Timber bridges b. Masonry bridges c. Steel bridges d. Reinforced cement concrete bridges e. Pre stressed concrete bridges	**1**	

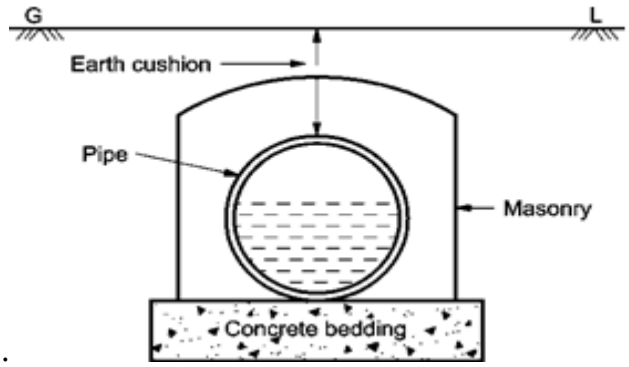
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	(a)	**3. According to span length:** a. Culverts b. Minor bridges c. Major bridges d. Long span bridges	1	4
		4. According to alignment: a. Straight bridges b. Skew bridges	1	
	(b)	**Describe in brief maintenance of bridges**		
	Ans.	The art of keeping the bridge components in good condition to keep the bridges in best serviceable order for a longer period is known as bridge maintenance or maintenance of bridges.	2	
		Necessity of bridge maintenance : 1. After the bridge is constructed and opened to traffic, its components such as foundations, pier, abutments, wing walls, approaches, flooring system, railing etc. are subjected to damages due to so many reasons. Therefore it is necessary to maintain bridge in such condition that it functions properly. 2. Maintenance of bridge becomes essential to keep them in best serviceable condition for a longer period.	2	4
	(c)	**Draw neat sketches of fixed plate bearing and rocker bearing**		
	Ans.	 **Shallow or fixed plate bearing**	2	4
		 **Rocker bearing**	2	

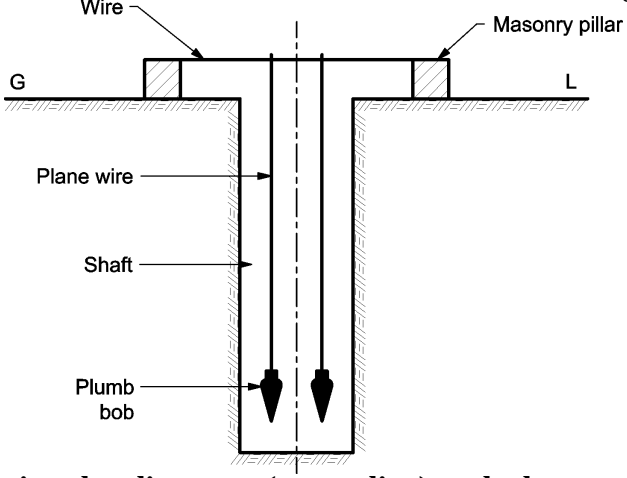
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	**(d)**	**State purpose of temporary bridge and types of temporary bridges**		
	Ans.	**Purposes of temporary bridge** 1.At the time of flood , it plays very important role in rescue operation 2. To divert the waterway, at the time of bridge construction. 3. To give the transportation facility for men, animal, light weight vehicles etc. at the time of maintenance of main bridge. 4. To connect shorelines temporary at the time of heavy rainfall. 5. At the time of war, it plays very important role in military operations	**2**	**4**
		Temporary bridges are classified as follows- • Bridges with intermediate supports Eg. (1) Crates (2) Cribs (3) Pile bents (4) Trestles • Bridges without intermediate supports Eg. (1) Cantilevers (2) Suspension bridges (3) Trusses • Floating bridges: Eg. (1) Boat bridges (2) Pontoon bridges (3) Raft bridge	**2**	
	(e)	**Describe in brief factors affecting bridge site**		
	Ans.	**Factors affecting bridge site are as follows-** **(1) Width of river :** • The smaller the width of river, the cheaper will be the bridge in its initial cost as well as maintenance cost. **(2) A straight reach :** • The river should have straight reach over a reasonable long distance on upstream side and downstream side of the bridge site so that the utility of bridge can be maintained for the design period. **(3) Foundations :** • The nature of soil at bridge site should be such that good sound foundations should be available at reasonable depth. **(4) Connections with roads :** • The approaches at the bridge site should be such that they do not involve heavy expenditure. **(5) Firm embankments :** • The embankment at bridge site should high, permanent, straight, solid and firm. • Such embankments will not get disturbed at the time of heavy floods and they do not allow the course of stream to alter. **(6) Materials and labour :** • The site of the proposed bridge should be such that labour, construction material should easily available nearby site. • This type of bridge site will provide economy in the overall cost of construction.	**4**	**4**

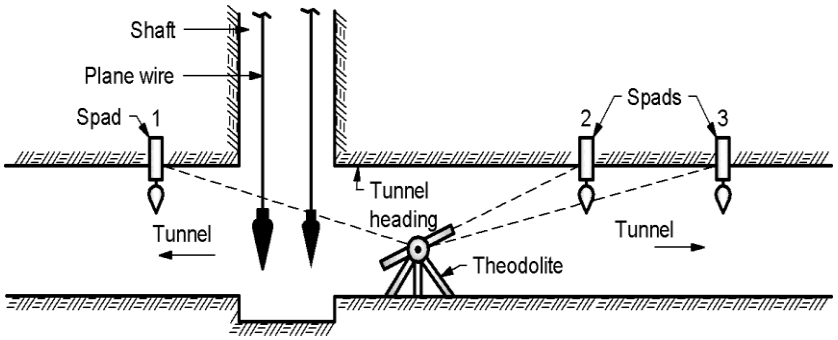
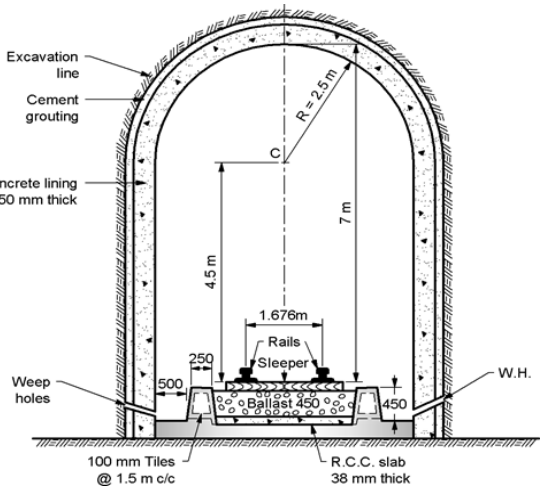
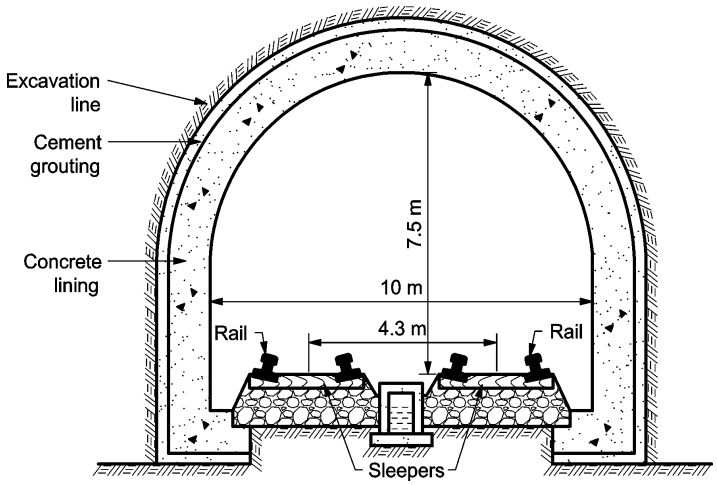
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	**(e)**	**(7) Right angle crossing :** • At bridge site, the direction of flow of water should be nearly perpendicular to the centre-line of bridge. Such crossing is known as right angle crossing. • This type of site will help in providing square alignment of bridge which will result in easy and economy in bridge construction. **(8) Velocity of flow :** • The velocity of flow at bridge site should be between the range of non - silting and non-scouring. **(9) Scouring and silting :** • There should be no scouring and silting at bridge site, which will result in minimum maintenance cost. **(10) Minimum obstruction to water way :** • There should be minimum obstruction to natural water way at the site of bridge. **(11) Sound, economical and straight approaches :** • The bridge site should provide sound, economical and straight approaches. • In case of curved alignment, the bridge should be on the tangent and not on the curve, since it is difficult to construct and maintain a curved bridge. **(12) Location of river tributaries :** • The bridge site should be away from the point of influence of large tributaries as far as possible. As it will help to protect the bridge from the possible harmful disturbances. **(13) Free board :** • Sufficient free board should be available for the passage of boats, ships under the bridge superstructure if the river is used for navigation purpose.	**1 mark Each (Any four)**	
	(f) Ans.	**Enlist types of culverts and explain an one with neat sketch** A culvert is defined as a small bridge constructed over a stream which remains dry for most part of the year. **Types of culverts :** Culverts are classified into following type : 1. Arch culvert 2. Box culvert 3. Slab culvert 4. Pipe culvert	**1**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	**(f)**	**Arch culvert** • The culvert having its superstructure consisting of single or number of arches constructed of any suitable masonry is known as arch culvert. • The arch culvert is provided with the abutments, wing walls and parapet. • An arch culvert of stone masonry may be adopted for span ranges of 2 m to 6 m. • Arch culvert are specially suitable where the approaches are to be constructed in cuttings.  **Arch culvert** **Box culvert :** • In case of box culvert rectangular or square boxes are formed of masonry, R.C.C. • Box have their floor and top slabs constructed monolithically with abutment and piers. • Box culvert is provided one or more number of units with individual spans ranging from 1 m to 4 m. • This type of culvert can be conveniently used for a single span of 3 m or for a double span of 6 m. • Box culverts are specially suitable when soil is soft and the load has to be distributed over wider foundation area.		

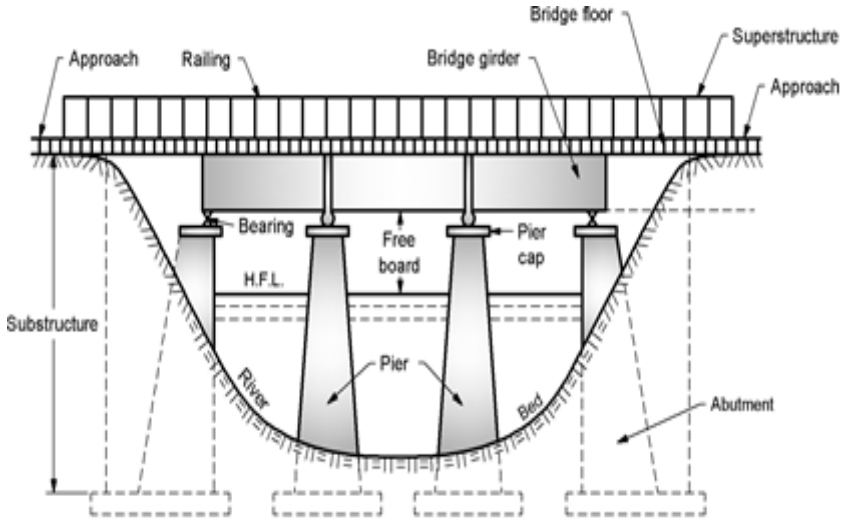
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	**(f)**	 **R. C. C. box culvert** **Slab culvert :** • A slab culvert consists of stone slabs or R.C.C. slabs supported on masonry wall • These culverts are constructed up to the span of 3 m. • The construction of slab culvert is relatively very simple. • This type of culvert can be used for highway, railway and bridges. Slab culvert are suitable where the bed of stream or canal is sufficiently firm.  **Pipe Culvert** • For small stream crossing the road or railway embankments one or more pipes may be laid to act as the culvert, such culvert is known as pipe culvert. • The diameter of pipe is always more than 300 mm. • Such type of culvert consists of cast Iron, steel or R.C.C. pipes held in position over concrete base. • The exact number of pipes and their diameters will depend on the discharge an height of bank. • Pipe culverts are suitable where the flow of water in the stream is very less and when discharge is low say upto 10 m^3/sec.	**1½ for sketch and 1½ for explanation (Any one method)**	**4**

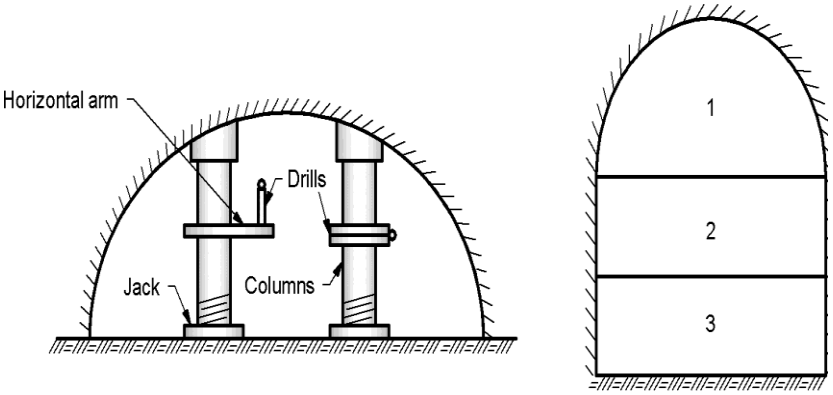
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	**f)**			**16**
Q.4		**Attempt any <u>FOUR</u> of the following:**		
	a)	**State precautions to be taken while construction of tunnels.**		
	Ans.	Depending on the purpose of tunnel, shape should be decided. 1. Cross - sectional dimensions of the tunnel should be decided to achieve economy in its construction. 2. In order to make proper use of labour and equipment, sequence of operation must be well planned previously. 3. Labour should be well organized to maintain continuous progress of the tunnelling operations. 4. The use of outdated and unsuitable tools must be avoided. 5. Each and every operation must be completed in scheduled time as far as possible. 6. Loading and hauling of muck should be carried out efficiently. 7. In order to achieve economy, the sequence and type of lining should be determined in advance. 8. Selection of multipurpose and uniform type of equipment should be made, according to the size and shape of the tunnel. 9. Pattern of blasting the material in different locations should be decided for maintaining speed of driving and safety.	**1 mark each** **(Any four)**	**4**
	b)	**Define shaft . State four purposes of providing shaft in tunnels**		
	Ans.	**Shaft-** The vertical wells or passages constructed along the alignment of a tunnel are known as shafts.	**1**	**4**
		The purposes of providing shaft in tunnel shaft are as follows i) To provide opening for removal of muck. ii) To expedite the construction work of the tunnel by starting excavation at several points at the same time. iii) To provide passageway for pumping out the water from the tunnel. iv) To provide natural ventilation during construction of the tunnel.	**3**	

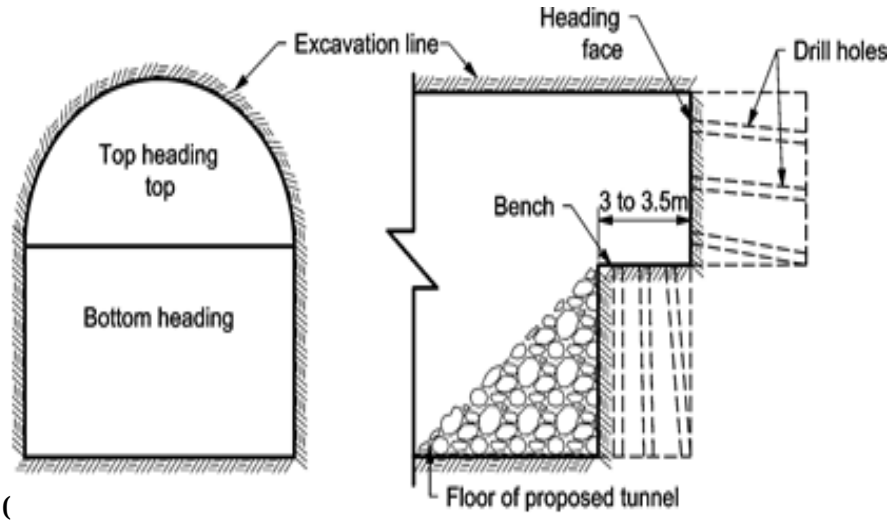
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	**c)**	**Define tunnel lining and state purpose of lining of tunnel**		
	Ans.	**Tunnel lining** A layer of timber, iron, masonry or concrete provided on the inside of a tunnel is known as lining.	**1**	
		Objects of lining or purpose of lining : 1. To provide the correct, desired shape to the tunnel. 2. To support the loosened rock pieces during blasting. 3. To increase the structural strength of soft places in the tunnel. 4. To improve the appearance of tunnel. 5. To prevent percolation of water inside the tunnel. 6. To reduce the maintenance cost of tunnel. 7. To house electrical fitting. 8. To withstand soil pressure when driven in soft rocks.	**1 mark Each** **(Any three)**	**4**
	d)	**Explain in brief transferring of center line in inside the tunnel with a sketch**		
	Ans.	First of all shaft is constructed. After construction of shafts, the center line of tunnel is to be transferred down the shafts. For this purpose, generally two small pillars are constructed on opposite edges of the shaft along the center line of the tunnel. On the top of pillars, the points corresponding to the centre line are correctly marked and a wire is then stretched between them. After this two plumb bob are suspended by piano wire inside the shaft as shown in figure above. Two points are then marked by lowering plumb bob to the bottom of the shaft. The line joining the two points represents the center line of the tunnel marked on the ground. These lines are further extended into the tunnel heading as the work advances, by a theodolite placed in the shafts. Points along the centre line are marked by a peg provided with plumb bobs , fixed to the roof of the tunnel as shown in figure	**2**	**4**
		 **Transferring the alignment (centre line) at the bottom of the shaft**	**2**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	**d)**	.  **(b) Transferring the alignment to inside of the Tunnel**		
	e) Ans.	**Draw tunnel cross section for railway track.**  Cross-section of tunnel for a single line broad gauge railway track  Cross-section of tunnel for a double line broad gauge railway track **(Note- any one diagram from the above should be considered)**	**3 marks for sketch and 1 mark for labelling**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	**f)** **Ans.**	**Describe in brief types of explosives used in tunneling.** Following three types of explosives are mainly used for tunneling - (1) Disruptive explosive (2) Power explosive (3) Liquid air explosive **(1) Disruptive explosives :** • These are commonly used explosives for tunnelling. • They are available in the market in the form of cartridges of size 2.5 cm to 20 cm in diameter and 20 cm to 70 cm in length. • Common type of disruptive explosives used in tunnelling are : (a) Straight dynamite (b) Gelatin dynamite (c) Semi - gelatin (d) Ammonia dynamite (e) Blasting gelatin **(2) Power explosives :** • These explosives are not commonly used in tunnelling • Types of power explosives used for tunnelling are : (a) Blasting powder • It is slow in burning, therefore it is not commonly used in these days. (b) Nitrate explosive (c) Nitraman • It is highly explosive but a special primer is required to detonate it, therefore it is rarely used in tunnelling. **(3) Liquid air explosive :** • These explosives usually consists of 95% oxygen at temperature of 191°c, which is absorbed by dipping a cartridge of absorbent. • Such explosives require special skill in their manufacture, transporting and storing. • Therefore, not commonly used. .	**2 mark Each** **(Any two)**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5		**Attempt any TWO of the following :**		**16**
	a) i)	**Draw neat sketch of a bridge .Show and label all the component parts.**		
	Ans.	 (b) Section	**3 marks for Neat sketch and 1 mark for labeling**	**4**
	ii)	**Define following terms.** **1) Afflux** **2) Effective span** **3) Economic span** **4) Clear span**		
	Ans.	**Afflux :** The maximum increase in water level due to obstruction in the path of flow of water is called as afflux.	**1**	
		Effective span of bridge : The center to center distance between any two adjacent supports of the bridge superstructure is called span or effective span of bridge.	**1**	**4**
		Economic span : The span for which, total cost of bridge is minimum is called economic span.	**1**	
		Clear span : The clear distance between any two adjacent support of the bridge superstructure is called clear span.	**1**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**b)**	**Enlist methods for tunneling in hard rock. Explain any one with neat sketch.**		
	Ans.	**The various methods for tunneling in hard rock are -** (i) Full – face heading method (ii) Heading and bench method (iii) Drift method	**1**	
		Full - face heading method : • As in this method whole section of the tunnel is attacked at the same time, this method is called as full - face heading methods. • In this method, vertical columns are fixed at the face of the tunnel and drilling is done on the whole section of the proposed tunnel. • The drill holes are charged with explosive and ignited at a time. • The size of the hole may vary from 10mm to 40 mm. • The muck is removed before the next operation of drilling holes. • Tunnel Boring Machine are well suited for full face method	**4**	
			**3 mark for Neat sketch with labeling**	
		Heading and bench method • In this method, the driving of the tunnel is done in two portions of its section. • The top portion is known as heading and bottom portion is known as bench. • The driving of top portion is done in advance of the bottom portion as shown in Fig. 4.8.2. • In this method of tunnelling the top portion or heading will be about 3 to 3.5 m ahead of the bottom portion as shown in Fig. 4.8.2. • The holes are drilled into head and bench. • Then these holes are loaded together with explosive and then blasted.		

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**b)**			**8**

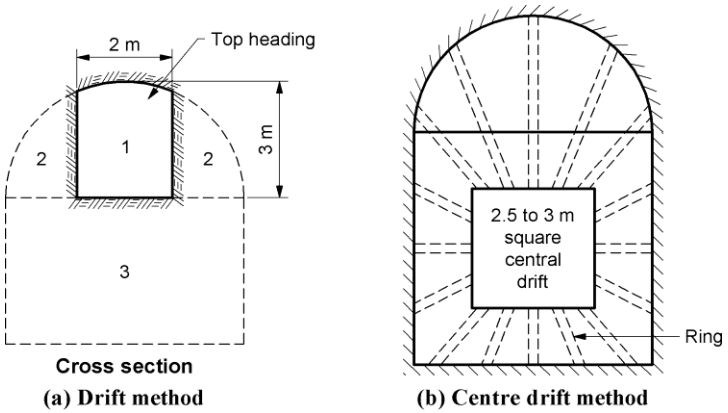
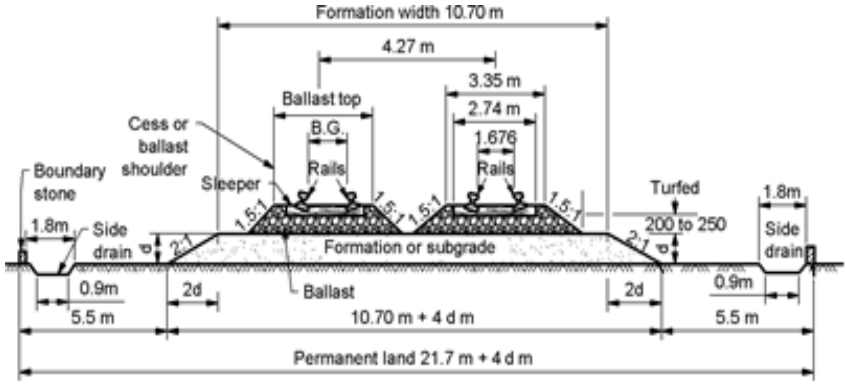
(a) Cross section (b) Longitudinal section

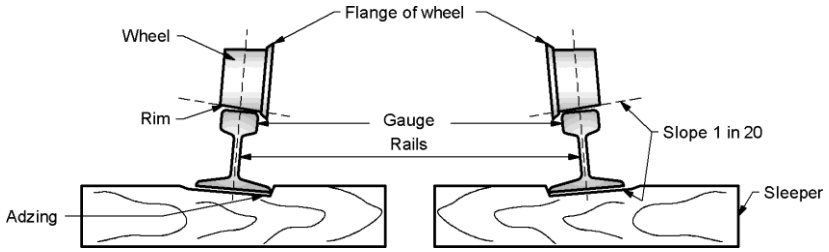
: Heading and bench method

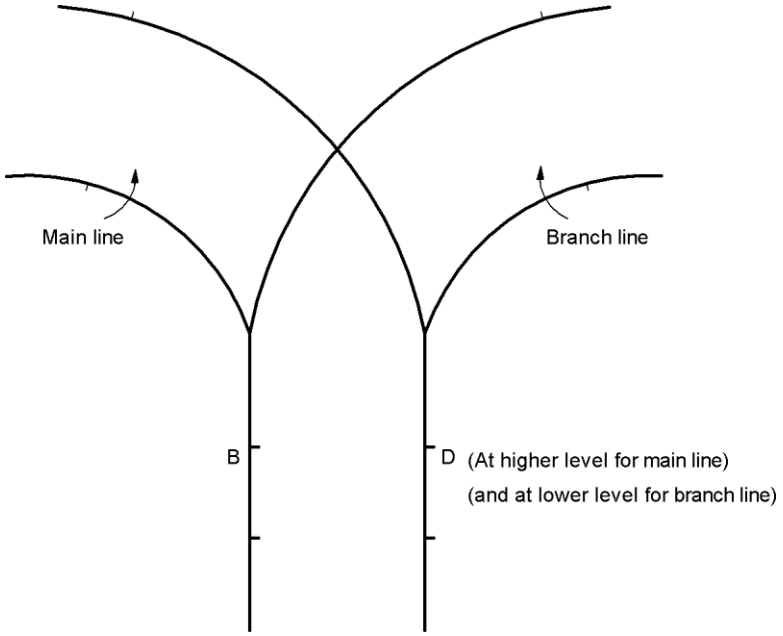
- Firing of bench holes is done just before the heading holes are fired.
- After this mucking is done manually.

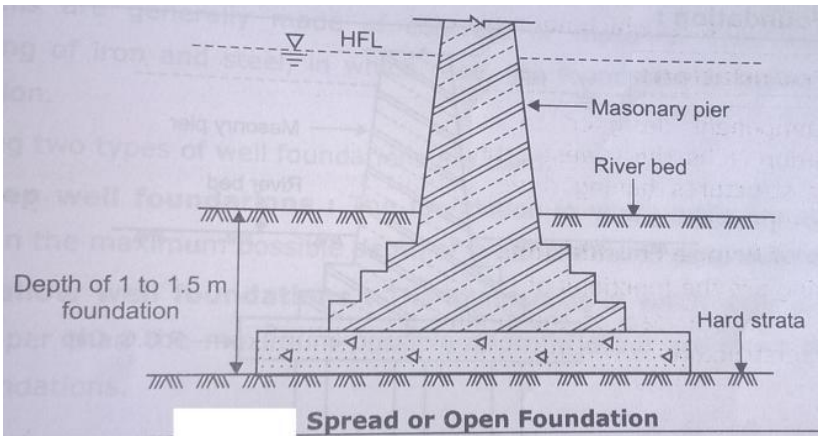
Drift method

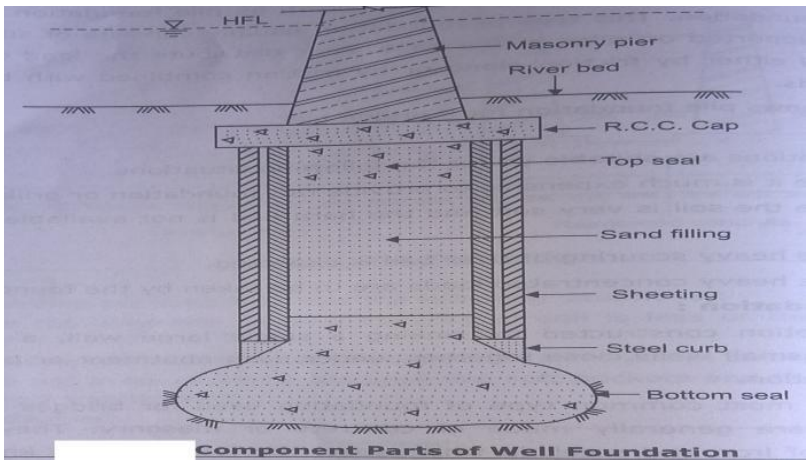
- It consists in driving small size heading. Centrally at top or bottom of the face, which is later enlarged by widening and benching.
- The main operations involved in this method are as follows :
  - (i) Boring or blasting a top centre heading of drift.
  - (ii) Widening and enlarging.
  - (iii) Benching in stages.
- In this method, a drift of 2.5 m × 3 m (minimum) size or sufficient to accommodate the tunnelling machinery, labour and mucking equipment etc.
- After making the central drift, holes are drilled for widening the face of the proposed tunnel.
- These drilled holes are then loaded with suitable explosive and fired step by step as shown in Fig. and Fig shows types of drift.

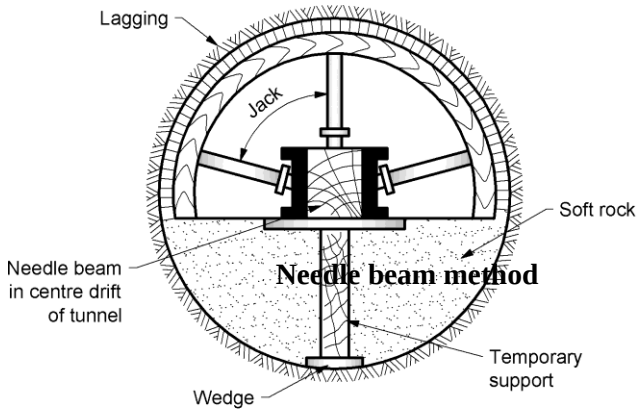
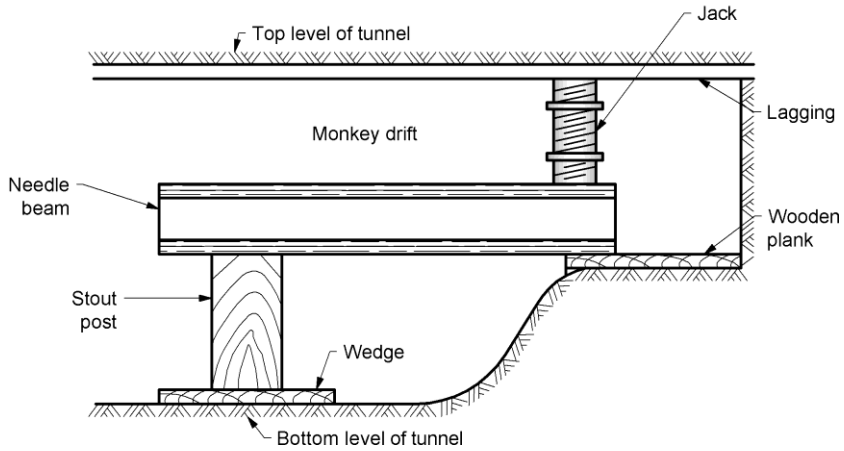
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	**b)**	 **(Note - Any one method from the above should be considered)**		
	c)	**Draw c/s section of broad gauge double line railway track in Embankment and name its components and state factors affecting while selection of gauge**		
	Ans.	 **Cross-section of a double broad gauge track in embankment**	**3 marks for neat sketch 1 Mark for neat labeling**	**8**
		Factors Affecting Selection of Gauge There are number of factors affecting the selection of gauge. Few of them are mentioned below : 1. Funds availability: For the railway project. 2. Cost of construction. 3. Volume of traffic: Heavy or light. 4. Revenue generation: Whether prospect is more or less. 5. Intensity of population: Thick or thin population. 6. Topography of the country. 7. Prospect of future development.	**1 mark each (Any four)**	

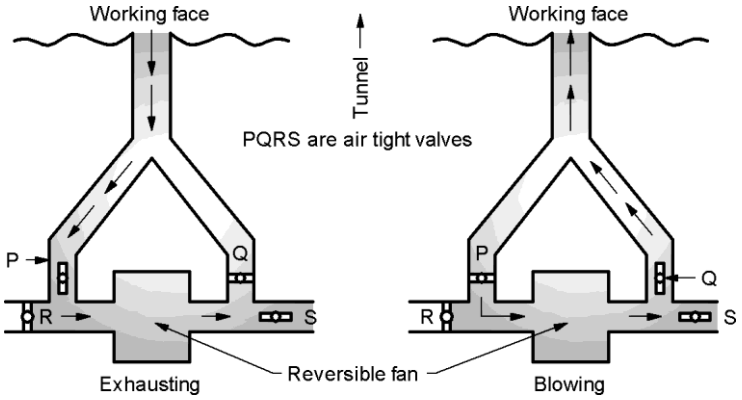
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
6		**Attempt any FOUR of the following:**		16
	a) Ans.	**Explain with sketch coning of wheels.** If the flanges of the wheel are flat then due to shocks there will be movement between wheel and the rails and due to which, vehicle will not be maintained in central portion and there will be unequal distribution of load. Therefore the flanges are made in the shape of cone with a slope of l in 20. This is termed as coning of wheel. It will also helps in decreasing the wear and tear of the flanges and the rail. To prevent rubbing inside face of rail and flanges, the distance between inside edge of flanges kept less than the gauge and thus the pressure is always maintained at the inner edge of rail due to coning of wheel.  **Coning of wheels**	**2** **2**	**4**
	b) Ans.	**Explain super elevation and negative cant.** **Super elevation:** The inner rail of track is kept low as compare to outer rail at different curves. This rising of outer rail is known as super elevation. 1. It permit running of trains at high speed on curved track without derailment. 2. It reduces wear and creep of rail on curved path. 3. It provides comfortable ride to passengers and safe movement of goods.	**2**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**b)**	**Negative cant**  **Negative cant** • On the curve where main track and branch track meets then the stage occurs such that the outer rail is below the inner rail, then it is called as negative cant or negative super elevation. • The negative cant helps the locomotive to change its direction from main line to branch line irrespective that outer rail should kept at higher level. • Now from fig shows the main track and branch track. The points 'D' is at higher elevation than B as in case of main track. But for branch track or turnout track, elevation of B should be higher than 'D' and thus super elevation provided is negative for branch track and this is called negative cant.	**2**	**4**
	c) Ans.	**Explain requirements of passenger bogie yard.** Requirements of passenger bogie yard are as follows- (a) It should be possible to lower the signals for the reception of trains from different directions at the same time. This facility is particularly necessary at junction stations so that all the trains what are to be connected with each other may be received at the same time. (b) Unless all trains are booked to stop at the station, it should be possible to run a train through the station at a prescribed speed. (c) In the case of an engine changing station, an engine coming from or going to a shed should cause minimum interference in the arrival and departure of trains.	**1 mark each (any four)**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
6.	**c)**	(d) An adequate number of platforms should be provided so that all trains can be dealt with at the same time. (e) There should be convenient sidings where extra carriages can be stabled after having been detached from trains or before their attachment to trains. (f) There should be provision of facilities for dealing with special traffic such as pilgrim and tourist traffic, parcels in wagon loads, livestock, and motor cars. (g) Stabling lines, washing lines, sick lines, etc., should be provided as per requirement.		**4**
	d) **Ans.**	**Enlist types of bridge foundation Explain any one type with neat sketch** Depending upon the nature and depth, bridge foundations of different categories are of the following types; 1. Spread or Open foundation 2. Raft foundation 3. Grillage foundation 4. Inverted Arch foundation 5. Pile foundation 6. Well foundation 7. Caisson foundation	**2**	
		Spread foundation: This type of foundation in shape is similar as provided for walls. It is best suited in situations where the scouring of the river bed is minimum and good hard soil is available within 2 to 3 m below river bed level. This type of foundation can be provided even if the bed contains erodible material as sand, but the scouring is prevented by driving sheet piles on upstream and downstream side and floor pitching.	**1**	
			**1**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**d)**	**Well foundation:** The foundation constructed by sinking a single large well, a twin well or a number of small well close together, under each abutment or pier is known as well foundation. This is the most common type of foundation used for bridges in our country. The wells are generally made of concrete or masonary. They may also be consisting of iron and steel, in which case, the foundation is known as tubular foundation. Deep well foundation and shallow well foundation are the two types of well foundation.  Component Parts of Well Foundation **(Note- Any one method from above should be considered)**		**4**
	e) **Ans**	**Explain needle beam method of tunneling in soft rock with neat sketch** In this method stout timber beam known as needle beam is used which forms the main temporary support during the excavation. • **Construction steps :** (a) First of all a small drift of about 1 × 1 m is prepared on the working face of tunnel. (b) The roof of this drift is then supported on lagging provided on wooden segments which are carried on the trench jacks as shown in the (c) The needle beam is placed horizontally, whose front end rests on drift and the rear end is supported on vertical stout post. (d) After excavation, the lining is provided to the tunnel section and mucking is done. • **Advantages of needle beam method :** (i) This method is economical. (ii) Brick lining can be easily done by this method.	**2**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**e)**	 **Needle beam method**	**1**	**4**
			**1**	
	f)	**Enlist methods of ventilation of tunnel and explain any one method with sketch.**		
	Ans.	**methods of ventilation of tunnel are as follows -** 1. Natural method 2. Mechanical method	**1**	
		(1) Natural method : • Natural ventilation is possible automatically due to difference of temperature inside and outside the tunnels. • Good ventilation is not possible by this method. • Natural ventilation can be improved by providing shafts at a suitable interval along the alignment of a tunnel during its construction.	**2**	
		This method is suitable when : (a) Tunnel is to be laid in the direction of wind. (b) A drift is driven from portal to portal. (c) Diameter of the tunnel is large but its length is small.		

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**f)**	**(2) Mechanical method :** Mechanical ventilation is done by blowing fresh air into a tunnel or by exhausting the foul air or dust from the tunnel by any system listed below : (1) Blowing process (2) Exhausting process (3) Combination of blowing and exhausting **(1) Blowing process :** • In this method of mechanical ventilation, fresh air is forced by on e or two blowers through the ducts, provided in the tunnel. • By this method, positive supply of fresh air at the working place can be obtained. • But the disadvantage lies in that the foul air, smoke and dust slowly move out, fogging the atmosphere inside the tunnel, especially in long tunnels. • This method is also known as propulsion method. **(2) Exhausting process :** • In this method of mechanical ventilation, air is sucked by one or two exhaust fans installed near the tunnel heading. • This creates vacuum due to which fresh air enters inside the tunnel. • This method has the special advantage of quick removal of dust and smoke from the working face. • This method is also known as vacuum method. **(3) Combination of blowing and exhausting process :** • In this method, blower and exhaust fans are provided for forcing fresh air in the tunnel and sucking foul air from the tunnel. • The blower and exhaust fans are installed in suitably spaced inlet and outlet shafts connected to the tunnel.  **Combination of blowing and exhausting process**	**1**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	**f)**	• Immediately after the blasting operation, the exhausting system is operated for 15 to 30 minutes, to remove the objectionable air. • After which blowing system is operated for forcing fresh air in the tunnel. • This method provides the most efficient ventilation system of tunnels. **(Note – 2 Marks for any one method from above and 1 Mark for sketch)**		